Mobile Intel® Pentium® 4 Processor-M and Intel 845MP Chipset Performance Brief

April 2002
Document Number: 250725-001

Executive Summary:

The Mobile Intel® Pentium® 4 Processor-M and Intel 845MP Chipset

The Mobile Intel® Pentium® 4 Processor-M is Intel's most advanced and powerful processor for mobile PCs, offering several innovative features for maximum performance, productivity, and manageability, and is based on the new Intel NetBurst™ micro-architecture. The Mobile Pentium 4 Processor-M is designed to deliver performance across applications and usage models where mobile PC users can truly appreciate and experience performance. For example, these applications include Internet audio and video streaming, digital image processing, digital video content creation, speech recognition, 3D graphics, CAD, multimedia, and multi-tasking user environments. The Mobile Pentium 4 Processor-M delivers world-class performance for consumer enthusiasts and business professionals. With all the performance needed to maximize both current and future Web technologies, as well as being designed to maximize investment protection, the Mobile Pentium 4 processor-M will continue to deliver world-class performance for mobile PC users well into the future.

The Mobile Pentium 4 Processor-M at 1.40 GHz, 1.50 GHz, 1.60 GHz, 1.70 GHz and 1.80 GHz enables high performance through the innovative NetBurst ™ micro-architecture-including Hyper Pipelined Technology, 400 MHz System Bus, Execution Trace Cache, and Rapid Execution Engine-in addition to a number of enhanced features-including the Advanced Transfer Cache, Advanced Dynamic Execution, Enhanced Floating-point and Multimedia units, and Streaming SIMD Extensions 2 (SSE2)-which provide a powerful combination to meet the higher performance and data bandwidth needs for today's and tomorrow's computing environment. These features are offered in Micro-FCPGA package form factor. The Mobile Pentium 4 Processor-M features Enhanced Intel SpeedStep™ Technology support, and a very low power state called Deeper Sleep which operates at a very low voltage. This greatly reduces processor power in the idle state, resulting in improved battery life.

The Mobile Pentium 4 Processor-M is the next dramatic step towards achieving even higher mobile performance. This exciting new processor, when used in conjunction with the requisite Intel SpeedStep Technology Applet or equivalent software, supports Enhanced Intel SpeedStep Technology. Enhanced Intel SpeedStep Technology has two performance modes and allows real-time dynamic switching of the voltage and frequency between two performance modes based on CPU demand. This occurs by switching the bus ratios, core operating voltage, and core processor speeds without resetting the system. The two performance modes are the Maximum Performance mode and the Battery Optimized Performance mode. The Maximum Performance mode operates at a higher frequency. The Battery Optimized Performance mode provides the best balance between performance and battery life and operates at a lower frequency.

The Mobile Pentium 4 Processor-M provides awesome performance for the Visual Internet and is fully compatible and binary compatible with previous Intel Architecture processors. The Mobile Pentium 4 Processor-M has been designed for the next decade of computing. The product will clearly deliver high performance on basic everyday usages; however, the product is designed for much more interactive, highly integrative usage models such as collaborative workgroups, Internet audio and streaming video, image processing, video content creation, speech, 3D, games, multimedia and multi-tasking user environments. It also delivers a world-class user experience across basic standalone office applications. The Mobile Pentium 4 Processor-M offers great performance for today's and tomorrow's applications.

The Intel 845MP chipset highly scalable chipset implements the next step in the evolution of the Intel Hub Architecture and was designed in tandem with the Mobile Pentium 4 Processor-M and innovative Intel NetBurst ™ micro-architecture. The Intel 845MP chipset was designed to maximize performance and enhance the PC user experience both on and off the Internet. Features such as a 400 MHz system bus offer a peak bandwidth of 3.2 GB/s, supports dual Double Data Rate (DDR) memory channels also offer a peak bandwidth of 3.2 GB/s that is balanced with the system bus, and the AGP 4X interface allows

graphics controllers to access main memory at over 1 GB/s. Intel Hub Architecture delivers twice the I/O bandwidth as previous generation northbridge/southbridge technology. With dedicated data paths to fully optimize the additional bandwidth, the Intel 845MP chipset delivers high performance and support for future Intel NetBurst™ micro-architecture-based processors. The Intel 845MP chipset family has the best combination of compatibility, affordability, and performance for the demands of high-performance based laptops.

Systems based on the Mobile Pentium 4 Processor-M include the latest features to simplify system management, decrease power consumption, and lower the total cost of ownership for large and small business environments. Mobile Pentium 4 Processor-M based systems offer great performance for today and tomorrow's applications, as well as the quality, reliability, and compatibility that is expected from the world's leading microprocessor company.

This performance brief introduces the Mobile Pentium 4 Processor-M, explains the technologies that make it work, examines the purpose and methods behind the industry's most useful benchmarks, and shows how the Mobile Pentium 4 Processor-M currently performs on each of the respective benchmarks. As new benchmarks are introduced, this performance brief will be updated as appropriate.

CONTENTS

Figures

Tables

1. Introduction

The Mobile Intel® Pentium® 4 Processor-M is Intel's most advanced and powerful processor for notebooks and is designed to deliver performance across applications and usage models where users can truly appreciate and experience performance. The Mobile Pentium 4 Processor-M delivers world-class performance for both, business professionals as well as consumer enthusiasts. With all the performance needed to maximize both current and future Web technologies, the Mobile Pentium 4 Processor-M will continue to deliver world-class performance for notebook users well into the future

The Mobile Intel Pentium 4 Processor-M is offered at speeds of 1.40 GHz, 1.50 GHz, 1.60 GHz, 1.70 GHz, and 1.80 GHz, while still offering low power and long battery life. In the Maximum Performance mode, the notebook can run the most complex business and Internet applications at very high speeds. In the Battery Optimized Performance mode, the Mobile Intel Pentium 4 Processor-M at 1.40 GHz, 1.50 GHz, 1.60 GHz, 1.70 GHz and 1.80 GHz will drop to a frequency of 1.20 GHz. The on-demand performance switches between peak and battery-optimized modes based on user needs, optimizing application performance and battery life.

When a Mobile Intel Pentium 4 Processor-M is used in conjunction with the Intel 845MP chipset family, the resulting platform provides reliable, balanced performance for today's mainstream notebook PCs, with headroom to remain productive as new applications emerge in the years to come. It offers support for DDR memory technology. The processor system bus frequency is 400 MHz.

This brief provides performance results for the following speeds of the Mobile Intel Pentium 4 Processor-M. A variety of benchmarks and software applications were run on each processor, and the results are normalized.

System performance does not depend on the microprocessor alone. Hardware and software system components—such as the operating system, the graphics and I/O subsystems, application software, and memory—may significantly affect performance results. For this reason, this Performance Brief illustrates Mobile Intel Pentium 4 Processor-M performance on a consistent system configuration. Details of the system configuration used for the performance scores throughout this brief can be found in Appendix A.

2. The Mobile Intel® Pentium® 4 Processor-M

The Mobile Intel® Pentium® 4 Processor-M, Intel's most advanced, most powerful mobile processor, is based on the new Intel NetBurst™ micro-architecture. The Mobile Pentium 4 Processor-M is designed to deliver performance across applications and usages where end users can truly appreciate and experience the performance. These applications include Internet audio and streaming video, image processing, video content creation, speech, 3D, multi-media, and multi-tasking user environments. The Mobile Intel Pentium 4 Processor-M delivers this world-class performance for consumer enthusiast and business professional mobile users.

Highlights of the Mobile Pentium 4 Processor-M:

- Available at 1.40 GHz, 1.50 GHz, 1.60 GHz, 1.70 GHz, and 1.80 GHz
- Featuring the new Intel NetBurst micro-architecture
- Supported by the Intel 845MP chipset
- Fully compatible with existing Intel Architecture-based software
- Internet Streaming SIMD Extensions 2
- Intel MMX™ media enhancement technology
- Memory cacheability up to 4 GB of addressable memory space and system memory scalability up to 64 GB of physical memory
- Based upon Intel's advanced 0.13µ manufacturing process

3. Mobile Intel® Pentium® 4 Processor-M Product Feature Highlights

The Intel® NetBurst micro-architecture delivers a number of new and innovative features including Hyper Pipelined Technology, 400 MHz System Bus, Execution Trace Cache, and Rapid Execution Engine as well as a number of enhanced features such as Advanced Transfer Cache, Advanced Dynamic Execution, Enhanced Floating-point and Multi-media Unit, and Streaming SIMD Extensions 2. Many of these new innovations and advances were made possible with improvements in processor technology, process technology, and circuit design that could not previously be implemented in high-volume, manufacturable solutions. The features and resulting benefits of the new micro-architecture are defined below.

- Low Power States and Enhanced Intel SpeedStep Technology Support

  The Mobile Intel Pentium® 4 Processor-M features the Stop Grant, Sleep, Deep Sleep, and Deeper Sleep low power states and is offered at 1.40 GHz, 1.50 GHz, 1.60 GHz, 1.70 GHz, and 1.80 GHz with Enhanced Intel SpeedStep™ Technology support. Highlights of this technology include:

  - Two performance modes - Maximum Performance mode for high performance, and Battery Optimized Performance mode for lower power consumption and improved battery life.
  - Real-time dynamic switching of the voltage and frequency between two performance modes based on CPU demand. This occurs by switching the bus ratios, core operating voltage, and core processor speeds without resetting the system.

- Hyper Pipelined Technology
  The hyper-pipelined technology of the NetBurst micro-architecture doubles the pipeline depth compared to the P6 micro-architecture used on today's Mobile Pentium III processors and Mobile Pentium III processors-M. One of the key pipelines, the branch prediction / recovery pipeline, is implemented in 20 stages in the NetBurst micro-architecture, compared to 10 stages in the P6 micro-architecture. This technology significantly increases the performance, frequency, and scalability of the processor.

- 400 MHz System Bus
  The Mobile Pentium 4 Processor-M supports Intel's highest performance mobile system bus by delivering 3.2 GB of data per second into and out of the processor. This is accomplished through a physical signaling scheme of quad pumping the data transfers over a 100-MHz clocked system bus and a buffering scheme allowing for sustained 400-MHz data transfers. This compares to 1.06 GB/s delivered on the Mobile Pentium III Processor-M's 133-MHz system bus.

- Level 1 Execution Trace Cache
  In addition to the 8KB data cache, the Mobile Pentium 4 Processor-M includes an Execution Trace Cache that stores up to 12K decoded micro-ops in the order of program execution. This increases performance by removing the decoder from the main execution loop and makes more efficient usage of the cache storage space since instructions that are branched around are not stored. The result is a

means to deliver a high volume of instructions to the processor's execution units and a reduction in the overall time required to recover from branches that have been mis-predicted.

- Rapid Execution Engine
  Two Arithmetic Logic Units (ALUs) on the Mobile Pentium 4 Processor-M are clocked at twice the core processor frequency. This allows basic integer instructions such as Add, Subtract, Logical AND, Logical OR, etc. to execute in half a clock cycle. For example, the Rapid Execution Engine on a 1.80 GHz Mobile Pentium 4 Processor-M runs at 3.6 GHz.

- 512KB Level 2 Advanced Transfer Cache
  The Level 2 Advanced Transfer Cache (ATC) is 512KB in size and delivers a much higher data throughput channel between the Level 2 cache and the processor core. The Advanced Transfer Cache transfers data on each core clock. As a result, the Mobile Pentium 4 Processor-M 1.70 GHz can deliver a data transfer rate of 57.6 GB/s. This compares to a transfer rate of 16 GB/s on the Mobile Pentium III processor at 1 GHz. Features of the ATC include:

  - Non-Blocking, full speed, on-die Level 2 cache
  - 8-way set associativity
  - Data clocked into and out of the cache every clock cycle

- Advanced Dynamic Execution
  The Advanced Dynamic Execution engine is a very deep, out-of-order speculative execution engine that keeps the execution units executing instructions. The Mobile Pentium 4 Processor-M can also view 126 instructions in flight and handle up to 48 loads and 24 stores in the pipeline. It also includes an enhanced branch prediction algorithm that has the net effect of reducing the number of branch mis-predictions by about 33% over the P6 generation processor's branch prediction capability. It does this by implementing a 4KB branch target buffer that stores more detail on the history of past branches, as well as by implementing a more advanced branch prediction algorithm.

- Enhanced Floating-Point and Multimedia Unit
  The Mobile Pentium 4 Processor-M expands the floating-point registers to a full 128-bit and adds an additional register for data movement which improves performance on both floating-point and multimedia applications.

- Internet Streaming SIMD Extensions 2 (SSE2)
  With the introduction of SSE2, the NetBurst micro-architecture now extends the SIMD capabilities that MMX technology and SSE technology delivered by adding 144 new instructions. These instructions include 128-bit SIMD integer arithmetic and 128-bit SIMD double-precision floating-point operations. These new instructions reduce the overall number of instructions required to execute a particular program task and as a result can contribute to an overall performance increase. They accelerate a broad range of applications, including video, speech, and image, photo processing, encryption, financial, engineering and scientific applications.

- Features Used for Test and Performance / Thermal Monitoring:

  - Built-in Self Test (BIST) provides single stuck-at fault coverage of the microcode and large logic arrays, as well as testing of the instruction cache, data cache, Translation Lookaside Buffers (TLBs), and ROMs.

- IEEE 1149.1 Standard Test Access Port and Boundary Scan mechanism enables testing of the Mobile Pentium 4 Processor-M and system connections through a standard interface.
- Internal performance counters can be used for performance monitoring and event counting.
- Includes an on-die thermal diode and a new Thermal Monitor feature for thermal management purposes
- The Mobile Pentium 4 Processor-M has a maximum junction temperature (T_J) specification of 100°C.

4. Intel® 845MP Chipset Product Feature Highlights

As the next step in the evolution of the Intel® Hub Architecture, the Intel® 845MP chipset was designed in tandem with the Mobile Intel® Pentium® 4 processor-M and innovative Intel® NetBurst micro-architecture. Intel Hub Architecture delivers twice the I/O bandwidth as previous generation northbridge / southbridge technology. With dedicated data paths to fully optimize the additional bandwidth, the Intel 845 chipset delivers high performance and support for future Intel NetBurst micro-architecture based processors.

The 82845 Memory Controller Hub (MCH) delivers support for either PC1600 and PC2100 DDR memory technology and a 400 MHz system bus, providing the latest graphics support through 1.5V AGP4X technology. Together these features deliver the highest total bandwidth capabilities to the PC platform. The enhanced 82801BA I/O Controller Hub 3 (ICH3-M) delivers twice the I/O bandwidth over traditional bridge architecture and provides dedicated data paths to fully optimize the additional bandwidth. The ICH3-M makes a direct connection from the graphics and memory for faster access to peripherals and provides the features and bandwidth required for a high performance notebook.

In addition to advanced application support, the Intel 845MP chipset was designed with the following feature to enhance the end-user experience:

- 400 MHz system bus delivers a high bandwidth connection between the Mobile Pentium 4 processor-M and the platform. To ensure maximum performance, the system bus is a single DDR channel providing up to 2100 MB/s, providing 3x the bandwidth of platforms based on the Mobile Intel® Pentium® III processor-M.
- DDR memory channels deliver up to 2.1 GB/s of memory bandwidth to the processor. High memory bandwidth, coupled with an efficient protocol, deliver balanced platform support and provide the memory bandwidth necessary to extract the highest performance from the Mobile Pentium 4 processor-M.
- The AGP4X interface allows graphics controllers to access main memory at over 1 GB/s, twice that of previous AGP platforms. With DDR memory and AGP4X, the Mobile Pentium 4 processor-M delivers the next level of 3D graphics performance.
- Three host USB controllers double the bandwidth available for USB peripherals to 24Mbps over six ports. This results in a significant increase over previous integrated 1-4 port hubs at 12Mbps.
- The latest AC97 audio delivers six channels of audio for enhanced sound quality and full surround sound capability for live broadcast and other Digital Dashboard programming.
- LAN Connect Interface (LCI) provides flexible network solutions such as home phone line, 10/100 Mbps Ethernet, and 10/100 Mbps Ethernet with LAN manageability.
- Dual Ultra ATA-100 controllers support the fastest IDE interface for transfers to storage devices. Additional performance is gained with Intel's Storage Driver over standard ATA drivers.

- Support for ACPI- defined power states C1-C4, S1, S3-S5
- Support for Enhanced Intel SpeedStep™ Technology
- Support for "Deeper Sleep" power state
- Allows wake-up from sleeping states S1-S4

Designed to balance performance and power in the Mobile Pentium 4 processor-M, the Intel 845MP chipset delivers a robust foundation for the most sophisticated end-user applications. The 845MP chipset offers innovative design, high-speed memory, and configuration options that optimize performance and provide a solid base for the Mobile Pentium 4 processor-M.

5. Performance Summary

Productivity Performance - SYSmark* 2002

SYSmark* 2002 is a suite of application software and associated benchmark workloads developed by the Business Applications Performance Corporation (BAPCo), a non-profit consortium of leading computer industry publications, independent testing labs, PC hardware manufacturers, semiconductor manufacturers, and software publishers. SYSmark* 2002 is a tool that measures system performance on popular business-oriented applications in the Microsoft* Windows operating environment.

SYSmark 2002 contains fourteen application workloads that are divided into two categories:
Office Productivity:

- Dragon* Naturally Speaking* Preferred Version 5
- McAfee* VirusScan* 5.13
- Microsoft* Access* 2002
- Microsoft Excel* 2002
- Microsoft Outlook* 2002
- Microsoft PowerPoint* 2002
- Microsoft Word* 2002
- Netscape* Communicator* 6.0/6.01
- WinZip* 8.0

Internet Content Creation:

- Adobe* Photoshop* 6.0.1
- Adobe Premiere* 6.0
- Macromedia* Dreamweaver* 4
- Macromedia Flash* 5.0
- Microsoft Windows Media Encoder* 7.1

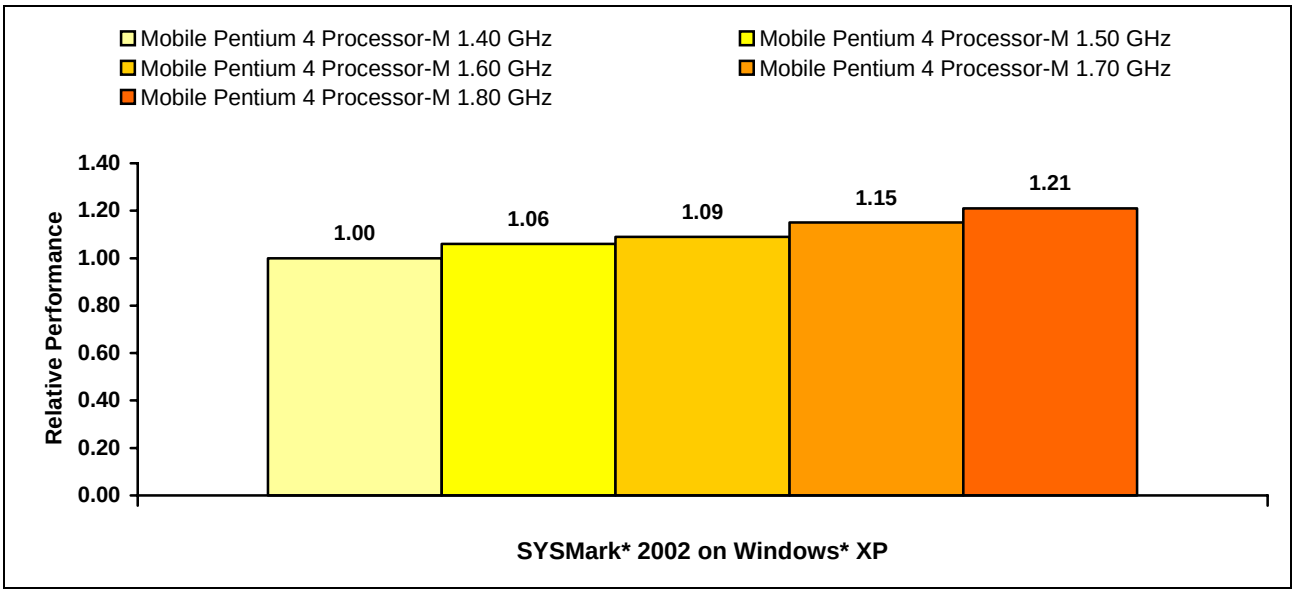

Figure 1. Mobile Intel Pentium 4 Processor-M on SYSmark 2002

Internet Performance - WebMark* 2001

WebMark* 2001 is an Internet benchmark designed and developed by Business Applications Performance Corporation (BAPCo) and MadOnion.com*. In addition to an Overall Score, WebMark2001 measures PC client performance across three different Internet usage models: Business-to-Business (B2B), Business-to-Consumer (B2C), and Intranet Business (B). WebMark2001 also measures the performance of the PC client on various technologies that are used within the benchmark, such as Flash* (operations per second), Java* (operations per second), XML (operations per second), and Video performance (frames per second).

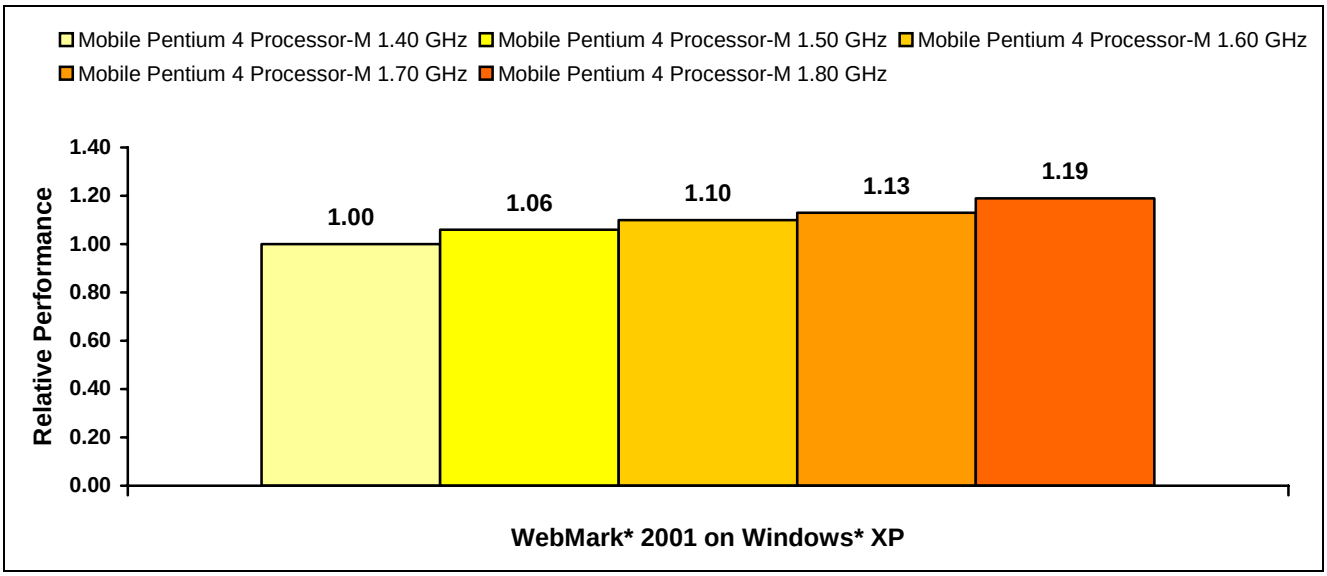

Figure 2. Mobile Intel Pentium 4 Processor-M Performance on WebMark 2001

Audio Encoding - MAGIX* MP3 Maker* Gold V.2.39

Sharing music is one of many popular uses of the Internet today. The MP3 file format is one of the more commonly used file formats used to share music since it enables high-fidelity sound with a relatively small file size. One of the more compute intensive steps in creating an MP3 file involves an encoding process going from a .wav file format to an .mp3 file format and there are software applications available today that help make this process easy. The MAGIX* MP3 Maker* V.2.39 Gold is an application that lets a user create MP3 files from an audio CD.

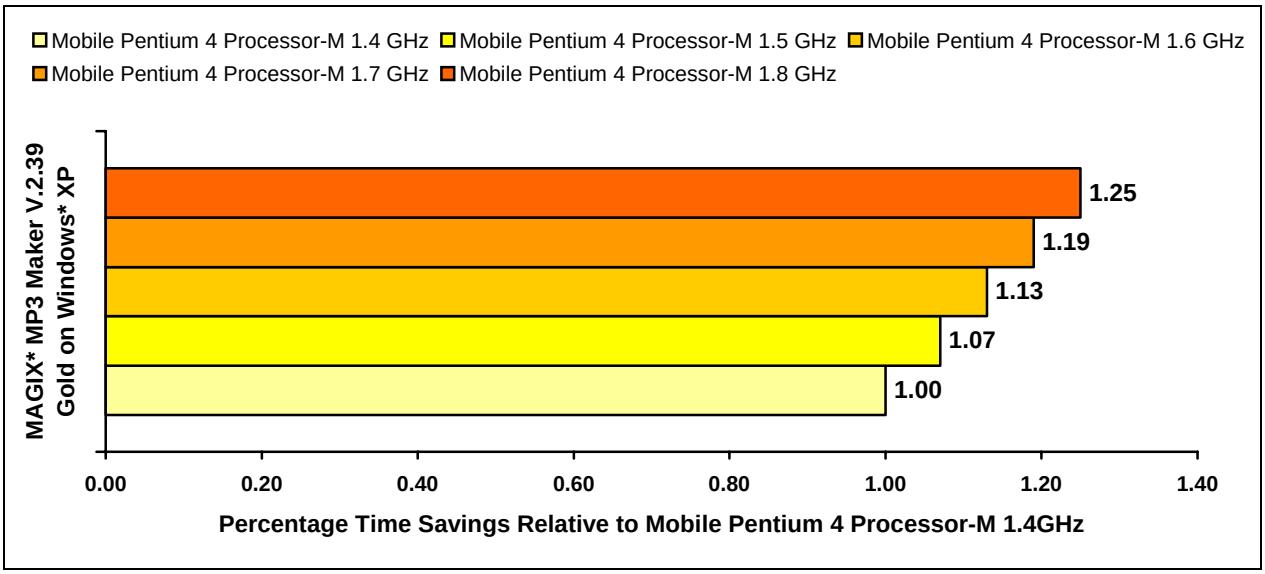

Figure 3. Mobile Intel Pentium 4 Processor-M Performance on MAGIX MP3 Maker v2.39 Gold

Digital Video Encoding - FlaskMPEG* V.0.6 with DivX* 4.11 Codec

Often before digital video is shared over the Internet it is either encoded into a file format that supports compression of the digital video into a smaller file size, or it is encoded into one of the popular video streaming formats commonly found on the Internet. FlaskMPEG* 0.6 with DivX* 4.11 Codec takes MPEG streams and encodes them into another video format.

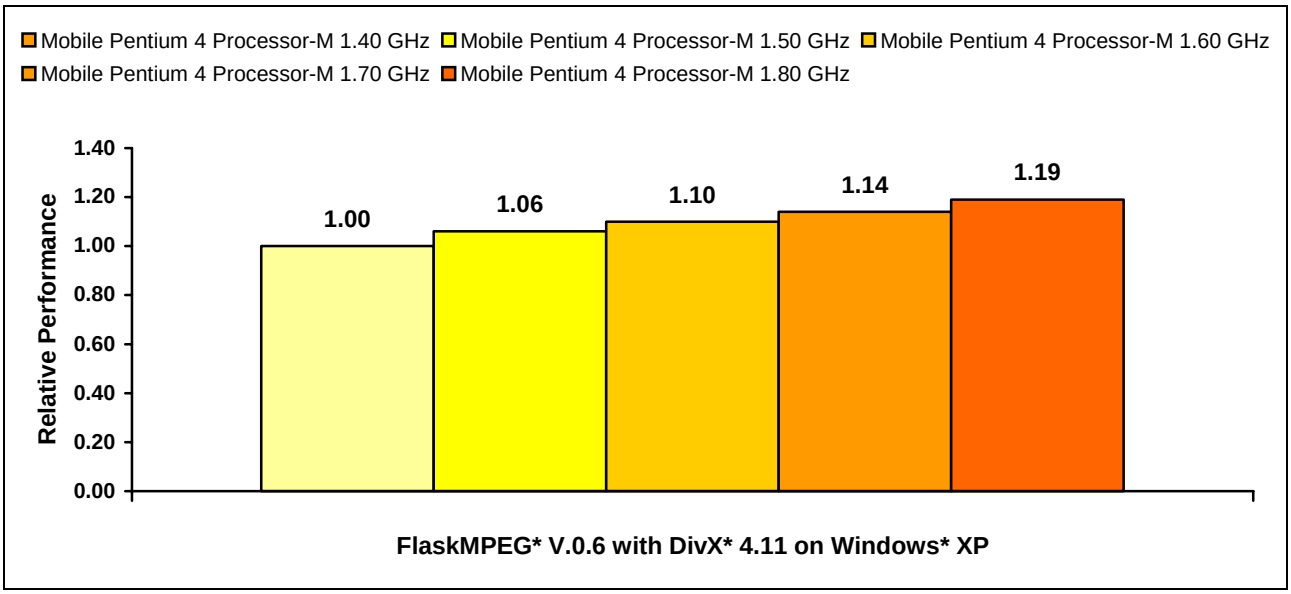

Figure 4. Mobile Intel Pentium 4 Processor-M Performance on FlaskMPEG V.0.6 with DivX 4.11

Digital Image Editing – Adobe* Photoshop* V.6.01

Today's mobile usage models include users editing digital images. The Mobile Pentium 4 Processor-M and its platform augment the experience of home and office users creating images for the Internet, logos and advertising. The fast completion time for editing and filtering images on Mobile Pentium 4 Processor-M based systems delivers rich creative experiences. This usage model is represented by Adobe* Photoshop* V.6.01.

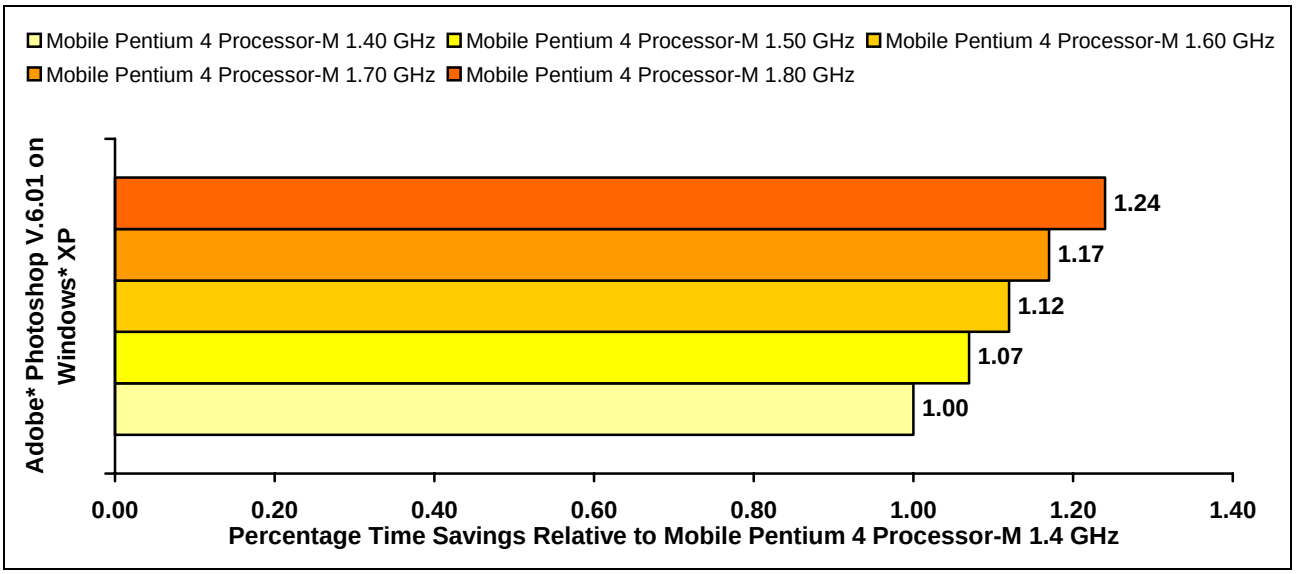

Figure 5. Mobile Intel Pentium 4 Processor-M on Adobe Photoshop V.6.01

3D Content Creation – NewTek* LightWave* 3D V.7.0b

Rendering applications demonstrate the new levels of complexity that can be achieved by running the latest software on powerful systems. LightWave* 3D is a 3D graphics and animation package from NewTek* used to create scenes for television film and games as well as print, web authoring and other media that involve 3D solutions. Animators using systems based on the Mobile Pentium 4 Processor-M and its platform enjoy short render times for television and movie productions for a great design experience.

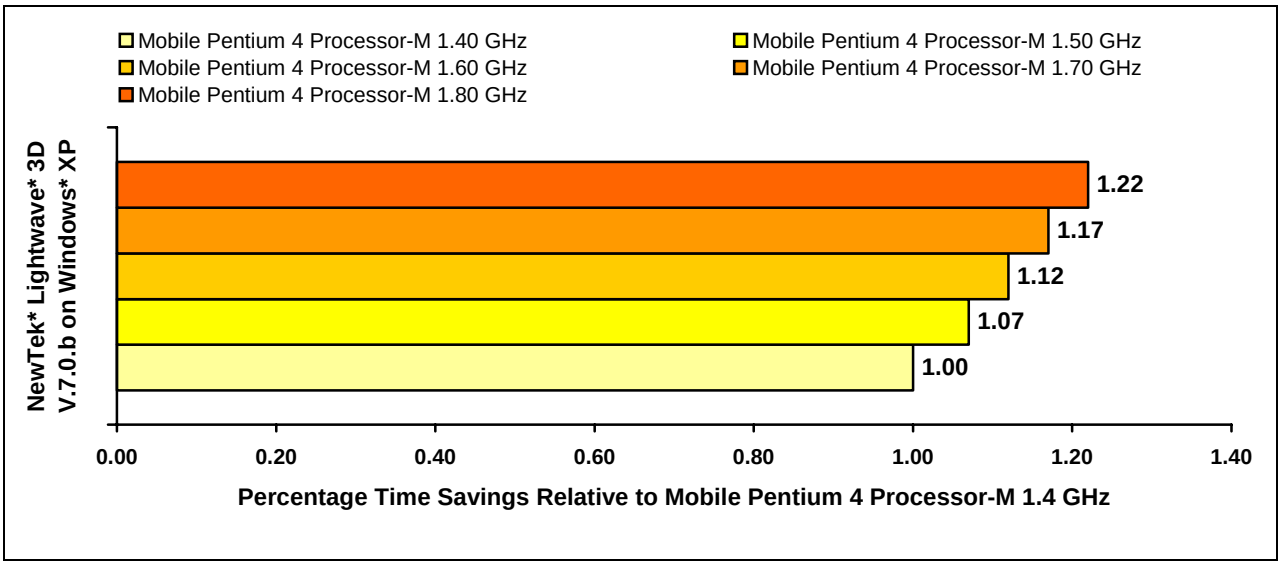

Figure 6. Mobile Intel Pentium 4 Processor-M Performance on the NewTek LightWave 3D V.7.0b

6. Summary

Table 1 summarizes the benchmark and application software performance of the Mobile Intel® Pentium® 4 Processor-M at 1.8 GHz, 1.70 GHz, 1.60 GHz, 1.50 GHz relative to that of the Mobile Pentium 4 Processor-M at 1.40 GHz on Windows* XP.

Table 1. Normalized Performance Results

Benchmark/Application Software	Mobile Intel® Pentium® Processor-M 1.40 GHz	Mobile Intel® Pentium® Processor-M 1.50 GHz	Mobile Intel® Pentium® Processor-M 1.60 GHz	Mobile Intel® Pentium® Processor-M 1.70 GHz	Mobile Intel® Pentium® Processor-M 1.80 GHz
SYSmark* 2002	1.00	1.06	1.09	1.15	1.21
WebMark* 2001	1.00	1.06	1.10	1.13	1.19
MAGIX* MP3 Maker Gold V.2.39	1.00	1.07	1.13	1.19	1.25
FlaskMPEG* v0.6 with DivX* 4.11	1.00	1.06	1.10	1.14	1.19
Adobe* Photoshop* V.6.01	1.00	1.07	1.12	1.17	1.24
NewTek* LightWave* 3D V.7.0.b	1.00	1.07	1.12	1.17	1.22

Appendix A System Configuration

Table 2. System Configuration Used for Performance Measurement

Processor	Mobile Intel® Pentium® 4 Processor-M at 1.80 GHz, 1.70 GHz, 1.60 GHz, 1.50 GHz and 1.40 GHz
Vendor and System	Intel Sheeks Customer Reference Board
Processor System Bus Speed	400 MHz
System Memory Size/Speed	256-MB DDR 266
Motherboard Chip Set	Intel 845MP
Hard Disk	IBM* IC25T048ATDa05-A TravelStar* 48GB
Operating System	Windows* XP Professional
Sound	Integrated Sound
Video Controller	ATI* Radeon* Mobility Driver V.6.13.3275

Appendix B Average Power

The Mobile Intel® Pentium® 4 Processor-M featuring Intel SpeedStep technology consumes average power as shown below.

Table 3. Average Power Measurements

Processor	Voltage	Average Power
Intel Pentium 4 Processor-M at 1.40 GHz	1.3 V	<2W
Intel Pentium 4 Processor-M at 1.50 GHz	1.3 V	<2W
Intel Pentium 4 Processor-M at 1.60 GHz	1.3 V	<2W
Intel Pentium 4 Processor-M at 1.70 GHz	1.3 V	<2W
Intel Pentium 4 Processor-M at 1.80 GHz	1.3 V	<2W

Definitions/Data

Average power represents the power consumed by the processor while running typical office applications by an average user. Average power is measured by running industry standard benchmarks, such as Ziff-Davis* BatteryMark* 4.0.1 measured in Battery Optimized Mode.

Disclaimer

Power measurements are generally taken by running certain performance and/or battery life benchmarks on a specific computer system. Different measurements can be designed to approximate the various power characteristics of a component such as a processor, or of a computer system. Some of the often-measured power characteristics include thermal design power (or TDP) and average power. Examples of benchmarks used to measure power include: Ziff-Davis* BatteryMark* 4.0. Each processor's or system's power characteristics is measured using a particular computer system with specific hardware and software configuration. Such processors or computer systems may or may not be commercially available at the time when the measurements are taken but reasonable effort is made to make such measurements on processors and computer systems currently or soon-to-be commercially available. Where non-commercial systems are utilized for power measurements due to special instrumentation needs, reasonable effort is made to ensure that such non-commercial systems have characteristics, configurations, and properties similar to those of a computer system currently or soon-to-be commercially available, although such similarity cannot be guaranteed. Actual power measurement results may vary depending on the specific hardware and software configuration of the computer system measured, the power characteristics of those computer components not under direct measurement, variation in processor manufacturing processes, the benchmark utilized, the specific ambient condition under which the measurement is taken, and other factors. Buyers should consult other sources of information to evaluate the power characteristics of the systems they are considering purchasing. For more information about power characteristics (such as TDP or average power), and a description of the systems and microprocessors used in the power measurements, and any other information about processor and system performance and power benchmarks, visit Intel's World Wide Web site at http://developer.intel.com/procs/perf/ and follow the appropriate links.

* Other names and brands may be claimed as the property of others.